The Tenets of Aerospace Power

The tenets of aerospace power provide a framework through which air and space doctrine can and should be applied. They point out areas that are enhanced in the aerospace medium by aerospace systems. These tenets—distilled through eight decades of experience—emphasize the strengths of aerospace power, describe how aerospace power can be best employed, and provide important guidelines and considerations for commanders who are planning strategy to achieve military objectives. Aerospace power is most effective when designed and employed in accordance with these tenets.

Centralized Control/Decentralized Execution

Centralized control is considered the "master tenet." Aerospace forces should be centrally controlled by an airman to achieve advantageous synergies, establish effective priorities, capitalize on unique strategic and operational flexibilities, ensure unity of purpose, and minimize the potential for conflicting objectives. This tenet remains the cornerstone to success in modern aerial warfare.

US air power in North Africa during World War II demonstrated the effectiveness gained through centralized control of air power. Following the landings in Northwest Africa in late 1942, Allied air power was parceled out to support specific ground units with mission priorities set by supported ground commanders. With forces parceled out and controlled by ground commanders, airmen were unable either to seize control of the air or to provide effective support for the ground forces in the face of centrally controlled and concentrated Luftwaffe resistance. The establishment of centralized control by US forces in North Africa, a practice successfully followed by the Royal Air Force (RAF), dramatically improved air power's effectiveness and turned around the failures of a previous series of fragmented attempts to counter Axis operations.[1] American airmen recognized the universal aspects of the North African "lesson" and in July 1943 published Army Field Manual (FM) 100-20, *Command and Employment of Air*

Power, which formalized the idea of centralized control of air power by an airman.[2]

Nonetheless, centralized control was often difficult to achieve. For example, the strategic bombing effort against Germany was a divided effort. Coordination between the RAF Bomber Command and the US Strategic Air Forces was often only accidental.[3] In the Korean conflict, the story was much the same, only this time the disconnect was between Far Eastern Air Forces and Navy carrier-based aviation. Eventually, a coordination committee, hardly the ideal agent for centralized control, achieved some degree of order and coordination.[4] In the Vietnam struggle, the situation was often even more fragmented. At one time or another, there were at least seven different air wars in progress with no one below the national command authorities exercising anything resembling centralized control.[5]

Execution of aerospace missions should be decentralized to achieve effective spans of control, responsiveness, and tactical flexibility. Even though the concept was professed in earlier conflicts, decentralized execution was formalized as a tenet of aerospace power in Air Force doctrine in 1971 in reaction to the manner in which the bombing of North Vietnam was directed.[6] Fearing escalation to a nuclear confrontation, President Lyndon Johnson took personal control of the Rolling Thunder bombing campaign (1965–1968), selecting not only targets but also often dictating timing, ordnance loads, sorties, and alternate targets. In a sense, Johnson's action was centralized control run amuck with all strategic, most operational, and many tactical decisions emanating from the president's now infamous Tuesday lunch meetings. The result was a campaign unresponsive to local conditions, a campaign that lacked both operational and tactical flexibility. More important, the campaign was a failure despite the expenditure of three years of intensive effort, much American blood, and uncounted treasure.[7]

There must be a balance between centralized control and decentralized execution. Maintaining control too tightly at high levels can lead to the Rolling Thunder situation described above. Too much or too little centralization has proved to be counterproductive, the

former delaying responsiveness and the latter leading to dissipation of effort. It is imperative that some forces (i.e., logistics and space) be controlled centrally when the same assets are used simultaneously in many parts of the theater, or even in different theaters. Based on experience from World War II, Korea, Vietnam, and Operation Desert Storm, the most effective and efficient scheme is control of all aerospace assets by a single joint force air component commander responsible for integrating employment of all aerospace forces within a theater of operations. Still, success in war at the tactical level requires attention to details and the ability to adapt quickly to exploit fleeting opportunities.

Although centralized control can effectively concentrate aerospace power within a campaign, commanders exercising such control are likely to be faced with too many units and too little time if they try to master the details necessary to make timely adjustments for tactical effectiveness. Moreover, if only one command center exercises control, it is likely to be large and relatively immobile, characteristics that make it easier to detect and attack. Should such a command center be attacked successfully, there would be no "graceful" degradation of control. All units would be suddenly left without direction. Decentralized execution answers these problems in span of control and survivability. In many cases, beginning in World War II, those exercising centralized control of air forces had defined areas of responsibility, assigned tasks and command of forces, and delegated authority for execution to subordinate air echelons.[8]

A successful example of centralized control and decentralized execution can be found in the Far East in the late summer of 1944. George Kenney had just become commanding general of Allied Air Forces and Fifth Air Force. Because of the decentralized execution General Kenney offered to his subordinate air commanders, the air forces were better able to plan and perform their varied missions with speed and flexibility.[9] The subordinate echelons were responsible for supervising the details and making the rapid adaptations that led to tactical success. This division of responsibilities between air echelons allowed each echelon to have smaller, more mobile command and

control nodes, making them more survivable. It also ensured that command and control of campaign air operations would degrade gracefully should an individual node be destroyed or degraded. More recently, the global reach and worldwide demand for systems such as space-based and logistical resources underscore the need for a dynamic network of global and theater control centers.

Modern technologies in command and control may seem to make decentralization of many important decisions increasingly inappropriate or even unnecessary. The complexities of "force packaging" may often require that many decisions concerning targets, routing, force composition, and tactics be made at a relatively high level. However, the basing of strike and support aircraft under a single commander (the composite-wing approach) and the use of mission-type tasking help alleviate the problem.[10]

Flexibility and Versatility

Flexibility, in the aerospace context, is both the capacity to respond well to changing circumstances and the ability to be proactive and shape change. Versatility reflects the capacity to adapt to many uses or functions. Leaders must not be dogmatic in their use of aerospace forces. Aerospace platforms and strategies will be most effective when used in flexible and versatile ways. Since aerospace power operates above the earth's surface, it is free from terrestrial barriers and can take advantage of the range and speed that constitute flexibility. The unique flexibility and versatility of aerospace power should be fully used and not compromised.

Most military forces can be used for a variety of purposes, can attack a variety of targets, can defend against a variety of attackers, and can do so in a variety of locations. But only aerospace forces possess the versatility to assume new roles, to be massed against any location for almost any purpose, and to do so quickly. The A-10, usually considered a close air support aircraft took on many interdiction missions during Desert Storm,[11] while one wing of F-111s, optimized as a long-range, deep-interdiction aircraft,

destroyed 920 tanks and armored fighting vehicles.[12] This flexibility and versatility mean that aerospace power has at least three potentially decisive uses.

First, aerospace power is the only form of military power that can always be used, at least conceptually, to produce a direct and immediate strategic effect. This ability flows from the fact that aerospace power can strike at an enemy's centers of gravity wherever or whatever those centers might be (with a possible exception found in insurgent warfare), often with sweeping implications.[13] In 1981 Israeli Prime Minister Menachem Begin believed the Iraqis intended to produce atomic weapons at Iraq's Osirak nuclear reactor site and use them against Israel. The 7 June Israeli air attack on Osirak destroyed Iraq's sole nuclear power plant, under construction and nearing completion.[14] Additionally, the April 1986 US raid on Libya, code-named Operation El Dorado Canyon, attacked terrorist camps and headquarters in an effort to punish international misbehavior by terrorist organizations and to send a message that there would be no sanctuaries for terrorists.[15] Neither distance nor terrestrial barriers can prevent such strikes if the force is properly trained and equipped. In practice, however, aerospace power's potential is restricted by rules of engagement and law to prevent contradiction or violation of policy and to focus on selected objectives.

The second decisive use of aerospace power is that of affecting the outcome of surface battles and campaigns before a shot is fired by surface forces. For example, the Battle of the Bismarck Sea not only prevented reinforcement of the Japanese army in New Guinea, it led the Japanese navy to abandon bulk resupply, evacuation, and movement of that army.[16] Air interdiction efforts can weaken, disrupt, delay, and destroy enemy forces before they come into contact with friendly forces.[17] For example, space-based indications and warning systems can help commanders prepare, deploy, and control forces for battles and campaigns.

The third decisive use of aerospace power is that of direct assistance in surface battles, perhaps with decisive effects. Engaged surface forces have come to rely upon aerospace forces to deliver precision

firepower at close quarters.[18] Either carrier-based or land-based aviation was used in direct support of every amphibious landing during World War II. Late in the Italian campaign, Eisenhower wrote the combined chiefs and said that air power was absolutely essential—the indispensable ingredient—to getting an amphibious landing on the beaches. Air power, using round-the-clock operations, kept the Salerno campaign from collapsing when the Germans tried to push the Fifth Army invasion force off the Italian beach in September 1943.[19]

Aerospace flexibility should not be limited to combat aircraft or the battlefield. Desert Storm was called "America's first comprehensive space war" because of the invaluable and irreplaceable flexibility and versatility provided by space assets. These assets played an important role in the detection of Scud missiles. Deployed satellites that were designed to detect intercontinental ballistic missile launches from within the USSR were pressed into service over Iraq supplying 90 to 120 seconds warning of a Scud attack.[20] During World War II, B-17s were modified to support Operation Chowhound, the airdrop of food over occupied Holland to forestall mass starvation of Dutch citizens.[21] In the Pacific, B-29s were used during Operation Matterhorn to ferry aviation gas, oil, bombs, spare parts, and food along the Hump routes.[22]

An equal contributor to the flexibility of air power is the air refueling mission. Air refueling contributes significant advantages by increasing the range and hence the mobility of aircraft. The day before Desert Storm began, seven B-52 bombers took off from their base in Louisiana on nonstop missions to the Middle East. Just as the Desert Storm air attack began, their crews sent their 35 air-launched cruise missiles toward eight Iraqi targets and returned safely to the United States. This mission lasted more than 35 hours and was made possible by the accompanying air refueling aircraft.[23]

Airlift has always been one of the most flexible and versatile components of air power during both peace and war. The 1947 and 1948 airlift operations sustained Berlin's population of two million for 13 months, creating an "air bridge" that Berliners will never forget.

Airlift continued to build on its historical successes. When Military Airlift Command aircraft reinforced Saudi Arabia following the invasion of Kuwait, they accomplished the equivalent of one Berlin airlift every six weeks between 7 August 1990 and 1 May 1991.[24]

A violation of this tenet occurs when we do not think about designing our equipment or using our forces in flexible ways. It took us 30 years to install cargo rollers in the KC-135. We fielded the B-1 and B-2 without the capability to deliver precision-guided conventional munitions.[25] The Republic F-105, originally designed to deliver a single nuclear bomb from an internal bomb bay, was eventually pressed into providing the necessary conventional mission capability sorely lacking at the onset of the Vietnam conflict. Additionally, it was further modified and employed in Wild Weasel missions.[26] The lack of foresight by the aircraft designers limited the effectiveness of even the best efforts to employ the aircraft in flexible and versatile ways. The F-105 proved ill-suited for the long-range conventional interdiction missions or the swirling "fur ball" dogfights of Southeast Asia.[27]

Priority

Demands and requests for aerospace forces will likely swamp commanders in any future war unless appropriate priorities for the use of these forces are established. Priorities will be derived from a thorough understanding of the enemy's capabilities, vulnerabilities, and intent. This understanding is essential lest scarce assets be unwittingly risked without having a significant impact on the outcome of the conflict. Effective priorities for the use of aerospace forces flow from an informed dialogue between the joint or combined commander and the air component commander. The air commander should assess possible uses as to their importance to first the war, second the campaign, and third the battle.

Air commanders should be alert for the potential diversion of aerospace forces to missions of marginal importance. Conceptually, the appropriate priorities are clear and logical. Because aerospace

forces are the only military forces that can strike virtually any target anywhere, their first-priority targets should be those whose destruction can have the greatest effect on the war as a whole—in short, the enemy's centers of gravity. Second-priority targets should be those that affect the outcome of an entire campaign within a theater of operations. The last priority should be those targets affecting only the outcome of individual battles.[28] Specific target priorities should reflect comparison of enemy capabilities, vulnerabilities, and behavior—identified by intelligence—with friendly objectives, capabilities, costs, risks, and policies.

Although the priorities form an elegant template for a commander's operational decisions, reality provides several impediments to mechanistic solutions. First, the primary objective of any aerospace component commander must be to achieve the degree of aerospace control that permits the exercise of appropriate priorities.[29] In 1943 General MacArthur concluded that his operations had to have the attainment of air superiority as a primary goal. He reversed his previous priorities and, following the recommendations of General Kenney, his air component commander, used his ground forces to complement the air forces in his quest for air superiority over the Japanese. MacArthur began to use ground forces primarily to secure bases from which his air forces could fly ever closer to the Japanese homeland.[30] Second, although the priorities have proven valid in conventional war, they may not be valid in either insurgent or nuclear war. Third, political constraints may not allow commanders to exercise the appropriate priorities. Fourth, the deeper one strikes behind enemy lines, the longer the delay usually is before there is a front-line effect. Thus, airmen could destroy an enemy's ability to support operations at the front and still be faced with an enemy victory at the front.[31] Fifth, in certain situations the outcome of a single battle could determine the outcome of a campaign, and the success of a single campaign could determine the outcome of the entire war. Sixth, it may be very difficult to resist demands for support from superiors, peers, or subordinates whose survival is at stake.

Regardless of the difficulties listed above, air commanders must have a rational set of priorities to avoid squandering their resources on targets of marginal importance. The objective should be to balance the finite resources against immediate and future wartime requirements. A mechanism for "meting out" critical resources at the strategic and operational levels of war is required to ensure sustained operations. Excessive use of precision munitions, for example, early in the campaign may prove decisive later if the supply is prematurely exhausted. With the caveats discussed above in mind, the priorities of war first, campaign second, and battle third remain appropriate general guidelines.

Synergy

Synergy is the combined or cooperative simultaneous action of separate forces that together have greater total effect than the sum of their individual effects. Internally, the missions of aerospace power, when applied in comprehensive and mutually supportive air campaigns, will produce effects well beyond the proportion of each mission's individual contribution to the campaign. This internal synergy was exemplified during World War II bombing missions escorted by fighter aircraft. When escorted by long-range fighters, heavy bomber formations were "bait" to bring German fighters to battle with American fighters and thus hastened the destruction of the Luftwaffe.[32] More recently, it was an Air Force/Army Special Operations mission code-named Task Force Normandy that had opening honors during day one of Desert Storm.[33]

Externally, aerospace operations can be applied in coordinated joint campaigns with surface forces, either to enhance or be enhanced by surface forces. Synergies between aerospace and surface forces form the essence of joint warfare. Control of the aerospace environment allows surface forces to function, and there are examples of surface forces playing a crucial role in seizing control of the air.[34] Ground maneuver and interdiction can form a powerful synergy.[35] Moreover, when aerospace forces are orchestrated directly

with surface maneuver forces, enemy surface forces can face a crippling dilemma. If the enemy responds to friendly maneuvers, he exposes himself to destruction from the air. If he takes cover to avoid air attack, he can no longer counter surface maneuvers.[36] Either course leads to defeat. Strategic attacks and naval blockades can reinforce one another as both missions seek to destroy the enemy's war economy and industry.[37]

Balance

The air commander should balance combat opportunity, necessity, effectiveness, and efficiency against the associated risk to friendly aerospace resources. Technologically sophisticated aerospace assets are not available in vast numbers and cannot be produced quickly. Even moderate attrition rates could significantly deplete the capability of the total aerospace war effort.[38] Therefore, careful balance between vulnerability versus payoff must be considered throughout a conflict.

This balancing act is particularly important for aerospace leaders because of three concurrent trends. The first and most obvious trend is toward more capable weapon systems. Technological progress since World War II has been startling. Some modern fighter-bombers can carry a greater bomb load than the largest heavy bomber of World War II (the B-29), carry that load much faster, and deliver it more accurately. Modern bombers, such as the B-1 and B-2, dwarf the capabilities of the B-29.[39]

Second, as weapon systems have become more capable, they have become much more difficult and expensive to produce. Therefore, fewer combat platforms are available, and rapid production of these sophisticated systems is difficult if not impossible. As a result, attrition has become magnified in importance.[40]

The third trend is the vast improvement in defenses against air attack. The development of surface-to-air and air-to-air missiles guided to their targets by radar or infrared sensors has caused great problems for airmen. However, scarce weapons platforms must not

always be unused or "held in reserve" awaiting high-priority missions. For example, the F-111F and F-15E aircraft, which are optimized for deep strike and battlefield interdiction, were used for "tank-plinking" operations during Desert Storm in an apparent violation of this tenet. Given the level of threat and the effectiveness and necessity of the operation, tank killing was in fact an appropriate mission for these aircraft.[41]

It is imperative that commanders carefully balance risk and opportunity. At the same time, they must expect situations in which balance is impossible, situations in which the necessity for action overwhelms risk. An example, driven by necessity, occurred during the October 1973 Yom Kippur War. During the first week, the Israelis lost 60 fighter aircraft. This rate was 20 times more than the production rate of the planes.[42] The potential consequences of such incidents only increase the need for careful balance in less dire situations. Although the situation may force a violation of this tenet, commanders must strive to maintain a proper balance between risk and gain.

Concentration

One of the most constant and important trends throughout military history has been the effort to concentrate, or focus, overwhelming power at the decisive time and place. Whether it be Napoléon's maneuvers, blitzkrieg tactics, or thousand-bomber raids, the purpose has been the same—to concentrate forces in time and space against enemy vulnerabilities. Aerospace power is most effective when it is focused in purpose and not needlessly dispersed. Sufficient forces must be concentrated to ensure a high probability of target destruction. To have to return and restrike a target exposes forces to increased long-term attrition and increased individual risk.

Concentration of aerospace power can be a daunting challenge. The targets against which this power can be used are almost limitless, ranging from battle-related targets on the front lines to strategic targets that may form the enemy's center of gravity for the entire war. The options are many and the demands on aerospace forces are great.

In such an environment, there is great temptation to divide the force into "penny packets" and to strike as many targets as possible in the shortest possible time. Depending on delivery accuracy and weapon capability, such a course of action may court a triple risk.

The first risk is that of failing to destroy the targets. If a target is not destroyed, as was the case in the first raid on Schweinfurt in World War II, commanders will be forced to restrike to finish the job. In so doing, the attacking forces will again be subject to attrition. Perhaps worse, the enemy may have increased defensive capabilities, having been put on notice by the first attack that the target is important and subject to restrike. In addition, the enemy may have used the time between attacks to reduce the target's vulnerability through such measures as dispersal, mobility, and hardening. The second risk is that of increasing the long-term attrition rate. The third risk is that of increasing the jeopardy of each penny packet and consequently risking defeat in detail.

A massively successful example of concentrated air power occurred in September 1918 during the Battle of Megiddo in Palestine. As the three retreating Turkish armies fell back toward the river Jordan, RAF units were quickly re-roled to attack the formations. The Turks were repeatedly attacked by the air forces, which bombed the fleeing columns until they ceased to exist as fighting units.[43]

Persistence

Persistence connotes continued efforts beyond initial successes. Air commanders should plan for restrikes against important targets to keep them continually out of commission or in a state of constant restoration, since destroyed targets may be rebuilt by resourceful enemies. The history of aerial attack is also the history of factories being rapidly repaired or rebuilt with new machinery installed, collapsed tunnels cleared, bridges rebuilt or replaced, and so forth. The lesson seems to be that the more important the target, the more effort the enemy will exert to defend, repair, replace, or rebuild it.[44]

General Kenney attributed his ability to gain control of the air and undertake other combat missions to the fact that Allied air forces in the Southwest Pacific made more persistent attacks than did the Japanese. Persistent reattacks of Japanese air bases was a primary factor in gradually extending air control from the eastern tip of New Guinea and eventually allowing the Allies to neutralize the Japanese base at Rabaul.[45]

During the Vietnam conflict, the Paul Doumer Bridge in North Vietnam was essential to Hanoi for the receipt of supplies from China and the Haiphong harbor. It was targeted and retargeted by US planners many times over a span of several years. It was repaired each time by the North Vietnamese until the Linebacker campaign, when it was taken out of commission for the remainder of the conflict. It was through this persistence that the US could keep the bridge at partial capacity and numerous North Vietnamese personnel preoccupied with repairing it.[46]

A violation of this tenet was experienced during World War II in the bombing of the synthetic rubber plant at Huels. After a devastatingly successful raid by Allied bombers on 22 June 1943, the plant was never again targeted for a major attack. This lack of persistence amazed German officials who had the plant repaired and at full production in six months. It was estimated later that three to five strong attacks would have completely eliminated the facility, and with it 30 percent of Germany's synthetic rubber production capacity.[47]

The timing of restrikes is of great importance. Strike too early and you only "bounce the rubble." Strike too late and the target has already accrued benefit to the enemy. Ideal timing calls for restrikes to destroy important targets just as they are becoming operational. Achieving such ideal timing depends on accurate and timely battle damage assessment and has the triple benefit of keeping an important target continually out of commission, wasting enemy efforts and materiel used in restoration, and severely testing the morale of those involved in restoring or trying to protect the target.

Putting It All Together

It is the duty of the commanders to plan the tenets of aerospace power into air and space operations and to apply them in an integrated effort to maximize the effectiveness of aerospace and surface forces. Failure to frame employment of aerospace power within these tenets in a campaign or battle will result in less than optimum combat capability.

In any successful campaign, the integrated synchronization of several tenets can be highlighted. For example, the efforts to destroy Iraqi tanks and artillery weapons during Desert Storm highlight the proper use of all tenets. Centralized control was evidenced through Gen H. Norman Schwarzkopf's official intention and direction to wear down the Iraqi field force.[48] General Horner, the joint force air component commander (JFACC), directed overall targeting emphasis and operations on the Iraqi Republican Guard. Decentralized execution at the battlefield level was seen through the advent of "kill boxes," whereby each airborne forward air controller (FAC) was given an area to patrol (the kill box), and he controlled all attack aircraft assigned to his kill box.[49] The tenet of flexibility and versatility can be seen in the use of A-10As with marker rockets or F-16 C/Ds assigned as FACs in the kill boxes to speed up the process of identifying targets and in the use of the F-111F and F-15E, usually considered deep-interdiction aircraft, for attacking individual tanks and artillery pieces.[50] The tenet of priority can be seen through the use of F-111Fs as bomb droppers in these kill boxes only after they had successfully participated in the previous weeks' priority targeting of command and control (C^2) nodes; nuclear, biological, and chemical (NBC) facilities; air defense architecture; and deep-interdiction targets.[51] The tenet of synergy is exemplified through the use of the Fast FACs (FACs in F-16s) to determine and pass initial targeting information. On some occasions, OH-58D Kiowa Scout helicopters laser designated for F-111Fs dropping laser-guided bombs.[52] The tenet of balance was taken into account prior to F-111F aircraft being used for tank-plinking missions. Plans called for attacks to be initiated from medium altitude, above threat capabilities, and relatively out of harm's way. This adjustment to attack profiles caused the proper

balance between the associated risks and the combat necessities to be realized. The tenet of concentration can be seen through the extensive use of precision-guided munitions against the dug-in tanks. Results that once would have taken many hundreds of sorties using thousands of "dumb" bombs could now be realized through relatively few sorties and the use of precision munitions.[53] Finally, the tenet of persistence can be seen through the continuous tank-plinking effort. At one time, General Horner designated an unofficial quota of destroying 100 tanks each night.[54]

Closing Thoughts

The tenets of aerospace power employment are interconnected, overlapping, and often interlocking. Flexibility and versatility necessitate priorities. Priorities determine synergies, levels of concentration, and degrees of persistence. Balance calculations influence all operations. When air and space forces are designed and employed in accordance with these seven tenets, they provide the most effective and efficient use of the aerospace medium. The combinations and permutations of interrelationships between the tenets are nearly endless, but none of the tenets is more than an empty phrase without the master tenet—centralized control. This oldest tenet of aerospace power remains the keystone of success in modern warfare.

Notes

1. Accounts of the air problems in Northwest Africa and the reorganization of air forces that resulted can be found in the following sources: Wesley F. Craven and James L. Cate, eds., *The Army Air Forces in World War II,* vol. 2, *Europe: TORCH to POINTBLANK, August 1942 to December 1943* (Chicago: University of Chicago Press, 1949; new imprint, Washington, D.C.: Office of Air Force History, 1983), 132–65; Richard G. Davis, *Tempering the Blade: General Carl Spaatz and American Tactical Air Power in North Africa, November 8, 1942–May 14, 1943* (Washington, D.C.: Office of Air Force History, 1989), 53–80; Gen William W. Momyer, *Airpower in Three Wars* (Washington, D.C.: Government Printing Office, January 1978), 39–45; and Robert Frank Futrell, *Ideas, Concepts, Doctrine: A*

History of Basic Thinking in the United States Air Force, 1907–1964 (Maxwell AFB, Ala.: Air University, 1971), 68–69.

2. FM 100-20 is one of the most important documents in American air power history. Often referred to as the "Magna Carta" of American air power, it recognized air power's equal status with surface forces in addition to the concept of centralized control by an airman.

3. In spite of the Combined Bomber Offensive directive issued at the Casablanca Conference in January 1943, RAF Bomber Command and its commander, Air Marshal Arthur Harris, were not enthralled with the American concept of pinpoint strategic bombing of key industrial targets selected for their importance to the German war effort. He called them panacea targets. Harris preferred to attack the major German cities by night in continuous attempts to burn them to the ground. Thus it was, for example, that Harris refused to send Bomber Command against Schweinfurt at night after the costly daylight precision raids in the fall of 1943, even though US airmen expected Bomber Command help with the target. Overall, the RAF and the US Strategic Air Forces conducted two not-so-combined bombing efforts rather than a totally integrated day and night campaign. Craven and Cate, vol. 2, 370–76; James Parton, *"Air Force Spoken Here": General Ira Eaker and the Command of the Air* (Bethesda, Md.: Adler and Adler Publishers, Inc., 1986), 309–28; and Max Hastings, *Bomber Command* (New York: Dial Press/James Wade, 1979), 191–212.

4. Momyer, 53–62; and Robert Frank Futrell, *The United States Air Force in Korea, 1950–1953*, rev. ed. (Washington, D.C.: Office of Air Force History, 1983), 48–55.

5. Momyer, 65–108; and Lt Col John J. Lane, Jr., *Command and Control and Communications Structures in Southeast Asia* (Maxwell AFB, Ala.: Air University, 1981), 37–104.

6. AFM 1-1, *Basic Doctrine of the United States Air Force*, 1971, 2-1.

7. Mark Clodfelter, *The Limits of Air Power: The American Bombing of North Vietnam* (New York: Free Press, 1989), 118–34; and Dennis M. Drew, *Rolling Thunder 1965: Anatomy of a Failure*, CADRE Paper 86-3 (Maxwell AFB, Ala.: Air University Press, October 1986), 28–42.

8. Col William B. Reed, ed., *Condensed Analysis of the Ninth Air Force in the European Theater of Operations* (new imprint, Washington, D.C.: Office of Air Force History, 1984). Also see Air Command and Staff School, Tactical Air Operations, AC&SS Pamphlet 36 (Maxwell AFB, Ala.: Air University, November 1950).

9. Kenney's prestige was high with the generals in the Southwest Pacific Area (SWPA), and MacArthur, observing that he had "found that it takes an aviator to run aviators," left air matters within the theater generally to Kenney. Kenney, in turn, never forgot that General MacArthur was the supreme military authority in the

SWPA. As commander, Kenney provided centralized control of the Fifth Air Force and Thirteenth Air Force in the southwest Pacific and the Seventh Air Force in the central Pacific. Kenney would decentralize execution first of all down to the numbered air force level, and then sometimes down to combat organizations below the numbered air force level. He encouraged Brig Gen Ennis Whitehead (Fifth Air Force) and Maj Gen St. Clair Streett (Thirteenth Air Force) to coordinate with each other and merely advise him of their decisions. Kenney informed them that his basic operational principle would be to ensure flexibility in tactics. Although Army Air Forces (AAF) entities would ordinarily operate within well-defined areas, their subordinate units might be switched or might cross boundary lines to meet the tactical situation. (Craven and Cate, vol. 4, 646–51).

10. Gen Merrill A. McPeak, "For the Composite Wing," *Airpower Journal* 4, no. 3 (Fall 1990): 4–12.

11. A military supply depot, 100 kilometers inside enemy territory, was attacked by A-10s and helicopters on 19 February 1991. Twenty-eight tanks, 26 other vehicles, 23 artillery pieces, and three ammunition storage facilities were destroyed. On this same day, A-10s reported successful strikes against Scud launchers, achieving a "double kill" on launchers in western Iraq. Wing Commander Gary Waters, RAAF, *Gulf Lesson One—The Value of Air Power: Doctrinal Lessons for Australia* (RAAF Base Fairbairn, Canberra, Australia: Air Power Studies Centre, 1992), 86.

12. Ibid., 101.

13. The possible exception to this capability is in insurgent warfare. In an insurgency, both the insurgents and the government have the same centers of gravity—the population of the target nation. Thus, it may not be possible to strike the centers of gravity with traditional military means. In any case, the decision to attack specific centers of gravity depends on such considerations as political policy and strategy as well as technical capabilities.

14. R. Ernest Dupuy and Trevor N. Dupuy, *The Encyclopedia of Military History* (New York: Harper & Row, 1986), 1362; and Amos Perlmutter, "The Israeli Raid on Iraq: A New Proliferation Landscape," *Strategic Review* 10, no. 1 (Winter 1982): 34–44. Accounts of this operation are scarce. An excellent re-creation of the probable events leading up to and during the mission is available in Dan McKinnon, *Bullseye Iraq* (New York: Berkley Publishing Group, 1987).

15. "Attack On Terrorism," *Aviation Week & Space Technology* 124, no. 16 (21 April 1986): 18–25. A personal account of the events surrounding the actual mission is in Col Robert E. Venkus, *Raid on Qaddafi* (New York: St. Martin's Press, 1992).

16. See, for example, Maj Charles M. Westenhoff, "Aggressive Vision," *Airpower Journal* 3, no. 3 (Fall 1989): 34–49.

17. This is the classic mission of air interdiction, which has traditionally been regarded as the second priority mission of tactical air forces (ranking only behind

counterair). Its ultimate objective is to "isolate the battlefield," an objective rarely accomplished. See FM 100-20, 11. A concise and readable definition and history can be found in Col John A. Warden III, *The Air Campaign: Planning for Combat* (Washington, D.C.: National Defense University Press, 1988), 83–99. See also Momyer, 163–245.

18. This is the classic mission of close air support, which has traditionally been regarded as the third priority of tactical air forces. FM 100-20, 11–12; Warden, 101–14; Momyer, 247–91; Benjamin Franklin Cooling, *Case Studies in the Development of Close Air Support* (Washington, D.C.: Office of Air Force History, 1990).

19. Salerno was chosen as the landing site in Italy because it was as far north as the Allied amphibious forces could come ashore and still be within the range of tactical fighters. These aircraft, based in Sicily, using drop tanks, and flying over large open water areas en route during their mission, were barely in range of the amphibious landing site. Many could provide only 20 minutes or less of combat. However, coordinated waves of fighters were synchronized over the beaches so that the beach was never left uncovered and vulnerable to the efforts of the Luftwaffe and the counterattacking German ground troops. A major setback was narrowly avoided—the Allies being nearer to a serious defeat than they would ever be during the remainder of the long Italian campaign. Eisenhower was "convinced" that but for concentrated use of naval and air strength, the ground troops might well have been pushed back into the sea. Craven and Cate, vol. 2, 492–545.

20. A satellite would detect the missile's launch and relay the data to the US Space Command headquarters at Cheyenne Mountain, Colorado. The information was analyzed, an impact zone was predicted, and then notification was sent to Central Command headquarters in Saudi Arabia (via a communications satellite). Marcia W. Smith, *Military and Civilian Satellites in Support of Allied Forces in the Persian Gulf War* (Washington, D.C.: The Library of Congress, 27 February 1991), 10.

21. David C. Rutenberg and Jane S. Allen, eds., *The Logistics of Waging War: American Logistics, 1774–1985 Emphasizing the Development of Airpower* (Gunter AFB, Ala.: Air Force Logistics Management Center, 1986), 114.

22. Ibid., 99. Without question, aviation gasoline was the real "long pole" in the Matterhorn tent. It took seven round-trips of 11 hours each to ferry in enough aviation gasoline for one mission against Japan.

23. Airman's World Section of *Airman*, 36 (March 1992): 10.

24. Gen H. T. Johnson, "From Shield to Storm: Why We're There," *Airlifter Quarterly*, Winter 1991, 9.

25. Gen Merrill A. McPeak, "Flexibility and Airpower," address, Scott AFB, Ill., 12 June 1993.

26. The two-seat F-105F, first delivered in May 1966, was the result of a decision to upgrade the Weasels from the F-100F to a higher performance aircraft. Maj William A. Hewitt, *Planting the Seeds of SEAD: The Wild Weasel in Vietnam* (Maxwell AFB, Ala.: Air University Press, June 1993), 15.

27. Richard Hallion, *Storm Over Iraq: Air Power and the Gulf War* (Washington, D.C.: Smithsonian Institution, 1992), 17–21.

28. The three priorities parallel those outlined in FM 100-20, 8–12.

29. Air superiority is a constant theme throughout the theoretical, historical, and doctrinal development of air power. Perhaps its most forceful presentation was in FM 100-20, which stated in its second paragraph, "THE GAINING OF AIR SUPERIORITY IS THE FIRST REQUIREMENT FOR THE SUCCESS OF ANY MAJOR LAND OPERATION [emphasis in original]." See also Momyer, 111–61; Warden, 13–20; and Richard H. Kohn and Joseph P. Harahan, eds., *Air Superiority in World War II and Korea* (Washington, D.C.: Office of Air Force History, 1983).

30. General Kenney believed the best and cheapest place to destroy the enemy was on the ground. He began a highly offensive campaign within three days of arrival in theater to replace his predecessor Lt Gen George H. Brett. See Warden, 24–30.

31. "Lag time" was documented in the US Strategic Bombing Survey. It noted that in spite of the enormous damage done to the German war economy by strategic bombing (primarily in 1944), "the full effects . . . had not reached the enemy's front lines when they were overrun by Allied Forces" in 1945. See *The United States Strategic Bombing Survey Summary Report (European War)* reprinted in *The United States Strategic Bombing Surveys (European War) (Pacific War)* (Maxwell AFB, Ala.: Air University Press, October 1987), 37.

32. Allied bombers flying without escort had a limited effect on destroying Luftwaffe aircraft. The same situation was occurring for Allied fighters flying in fighter sweeps (because the enemy would simply avoid engaging them). Eventually the Allied bombers and fighters would team up to attack key enemy industrial targets, forcing the Luftwaffe to engage the bombers and their fighter escort. The Allied tactic of close escort produced comparatively good, and in some cases outstanding, results and accelerated the collapse of the Luftwaffe, due in large part to the synergistic effect of close escort. See Craven and Cate, vol. 2, 327–38. Williamson Murray, *Strategy for Defeat: The Luftwaffe, 1933–1945* (Maxwell AFB, Ala.: Air University Press, January 1983), 231–55; Craven and Cate, vol. 3, *Europe: ARGUMENT to V-E Day, January 1944 to May 1945*, 30–66; and *Strategic Bombing Surveys*, 18–20. On one particularly costly raid on the U-boat yards at Kiel, 22 of an attacking force of 60 unescorted B-17s were lost as a result of the heaviest enemy fighter attack yet encountered by the Eighth Air Force. Ironically, the "Battle of Kiel" was hailed by both British and American air commands as a great victory due to the target being reached and the number of Luftwaffe aircraft

destroyed and damaged. Indeed, it could be termed a victory in terms of the bravery and determination with which the shattered force of bombers did in fact reach the target and drop its bombs. However, in the cold statistics which ultimately measure air victories, it was a sobering defeat. See Craven and Cate, vol. 2, 669–71.

33. Forty minutes before H-hour, Air Force Pave Low helicopters acted as navigational pathfinders leading a team of Army Apache gunships into Iraq to destroy two early warning radars. Behind the helicopters, eight F-15s entered Iraqi airspace and destroyed a nearby air defense command center. If left operational, these radar sites might have detected the initial waves of coalition fighters as they passed through this corridor heading for targets throughout Iraq. The sites were attacked and destroyed just 22 minutes before coalition force aircraft came through the radar coverage hole left by the successful Special Operations crews. Hallion, 166–7; and Gen H. Norman Schwarzkopf, USA, Retired, *It Doesn't Take a Hero* (New York: Bantam Books, October 1992), 414.

34. The clearest example of surface forces contributing to air control occurred during the 1973 Arab-Israeli conflict when the Israeli army seized and destroyed Egyptian surface-to-air missile sites that had played havoc with the Israeli Air Force. Kenneth P. Werrell, *Archie, Flak, AAA, and SAM: A Short Operational History of Ground-Based Air Defense* (Maxwell AFB, Ala.: Air University Press, December 1988), 139–46.

35. See Westenhoff, "Aggressive Vision."

36. This is the central theme of Lt Col Price T. Bingham's *Ground Maneuver and Air Interdiction in the Operational Art*, CADRE Paper 89-2 (Maxwell AFB, Ala.: Air University Press, September 1989).

37. Perhaps the best example of the synergy of strategic aerial attack and naval blockade is found in the Pacific theater in World War II. Naval forces destroyed the Japanese merchant marine and later clamped a blockade on the home islands. Meanwhile, strategic air power was systematically laying waste to Japanese industrial centers.

38. Note, for example, that a force of 100 aircraft, each flying two sorties per day and suffering 5 percent attrition, will be reduced by two thirds in just 10 days. Any increase in sortie rate or attrition rate would make the situation even worse.

39. Enzo Angelucci, *The Rand McNally Encyclopedia of Military Aircraft, 1914–1980* (New York: Military Press, 1983), 273, 416, 423, and 459.

40. The decline in force size since World War II is startling. For example, as of the end of 1988, the US Air Force had approximately 5,600 combat aircraft (those that put "fire and steel on targets"), including those in the National Guard and Air Force Reserve. See "An Air Force Almanac," *Air Force Magazine* 72, no. 5 (May 1989): 52–53. Compare the current inventory with some representative aircraft production numbers from the World War II years; for example, there were nearly

4,000 B-29s, nearly 9,000 B-17s, over 18,000 B-24s, nearly 16,000 P-51s, nearly 16,000 P-47s, and so on. See Angelucci, 246, 251.

41. F-111Fs using forward-looking infrared radar (FLIR) at night and at about 17,000 feet altitude dropped single 500-lb GBU-12s (costing around $5,000) to destroy a million-dollar tank and record the battle damage assessment (BDA). On some occasions, OH-58D Kiowa Scout helicopters laser designated for the F-111Fs. The F-111Fs' greatest success in these attacks occurred on the night of 13–14 February, when 46 aircraft, each armed with four GBU-12s, hit 132 tanks and armored fighting vehicles that were dug in and dispersed. See Waters, 207–8; and Hallion, 217.

42. The US began a massive resupply effort of equipment to the theater which aided somewhat in the stabilization of the situation. If this predicament had happened to US forces during combat, we would have had no other nation to come to our aid as supplier (or loaner) of aircraft. See Frank Aker, *The Arab-Israeli War* (Hamden, Conn.: Archon Books, 1985), 24–58.

43. In one particularly effective instance, the bulk of the Turkish Seventh Army was spotted as it wound its way down a steep-sided wadi. For four hours the RAF bombed and shot up the column until the gorge was completely blocked by more that 1,500 burnt and abandoned vehicles and 90 guns. See Anthony Livesey, *Great Battles of World War I* (New York: Macmillan Publishing Company, 1989), 170–7.

44. See, for example, *Strategic Bombing Surveys*, 15–22; Futrell, *Korea*, 437–74; and Momyer, 183–96.

45. George C. Kenney, *General Kenney Reports* (Washington, D.C.: Office of Air Force History, 1987), especially 25–428.

46. Maj Timothy J. Myers, "Paul Doumer Bridge: A Study of Leadership," student report, Air Command and Staff College, Maxwell AFB, Ala., 1986.

47. In addition to tires, the Huels plant also turned out several chemical by-products of military value. Given the vulnerability of synthetic rubber plants illustrated by this attack, the dependence of Germany on synthetic rubber, and the importance of the Huels plant in the production of this commodity, it is regrettable that the Allies did not follow up the bombing of 22 June. See Craven and Cate, vol. 4, 670–74.

48. Concerted efforts were being made to reduce the Republican Guard's ability to move quickly once a land offensive started. See Waters, 85.

49. Ibid., 86. The theater of operation was divided into specific areas that were targeted systematically. FACs in F-16s (called Fast FACs) were used to speed up the process of identifying targets.

50. The F-16 FAC aircraft carried extra fuel tanks instead of a full bomb load and worked with a dedicated airborne air refueling tanker. Waters, 85. The F-15Es used the low-altitude navigation and targeting infrared for night (LANTIRN) pods to improve their effectiveness. Hallion, 155. The F-111s using FLIR at night and

operating at about 17,000 feet altitude were able to locate the dug-in tanks. The use of F-111F Aardvarks in this way was unheard of and, as one officer said, "If I had stood up at Staff College a year ago and proposed using the F-111F for this type of attack, I would probably have been laughed out of the room." Hallion, 208.

51. Ibid., 86. Due to the preponderance of Allied aircraft available throughout the war, the Republican Guard had been, in fact, attacked constantly since the first week. By the fourth week, major emphasis was being placed on the Guard and front-line Iraqi troops, tanks, and armor. Soon after, these targets were attacked relentlessly, as were minefields and artillery emplacements, command posts, and observation posts in the field.

52. Ibid., 208.

53. An excellent article on this topic is Lt Col Ed Mann's, "One Target, One Bomb: Is the Principle of Mass Dead?" *Airpower Journal*, no. 1 (Spring 1993): 35–43.

54. The success of precision weapon attacks against Iraqi armor enabled General Horner to establish targeting quotas "like an insurance salesman," he recalled. "And I set the quota originally at a hundred tanks a night. And they started exceeding it and I bumped it to 150. But it became very productive. . . . The pilots called it tank-plinking. Now the tankers don't like to hear you say that. General Schwarzkopf asked that I not call it tank-plinking, and so I told the troops 'General Schwarzkopf does not want you to call it tank-plinking,' and that way I ensured that it will forever be known as tank-plinking." See Hallion, 217.